

C l a i m s

1. Loading system for transfer of hydrocarbons between
5 an installation on the sea bed (16) and a floating vessel
(10) in areas exposed to drifting ice, comprising a
submerged turret loading arrangement including a
loading/unloading buoy (19) configured for introduction
and releasable securement in a downwardly open receiving
10 space (15) in the vessel (10), a flexible riser (18)
extending from the sea bed installation (24) to the buoy
(19) intended to be securely connected to a corresponding
pipe on board the vessel (10), and a plurality of mooring
lines (17) connected to the buoy (19) and extending
15 outwards therefrom, the buoy (19) and the mooring lines
(17) serving as an anchoring system allowing the vessel
(10) to weathervane,
c h a r a c t e r i z e d i n t h a t the system
comprises:
20 protective means (20) for protecting the riser (18)
from impacts when the riser (18) is in an extended, load
transferring mode, and
a protective structure (24) located in or on the sea
bed (16) for protection of the riser (18) when in a
25 retracted position in a non-operative mode; that the
protective structure (24) containing means (28) for
storing the riser (18) in a protected position when
disconnected and retracted from the vessel (10).
- 30 2. Loading system according to claim 1, wherein the
riser (18) is protected at least along a portion of its
length, the riser protection (20) being preferably
suspended from the submerged turret buoy (19) by means of
a plurality of chains or wires (21).
- 35 3. Loading system according to claim 1 or 2, wherein the
riser protection (20) is formed by a plurality of
separate, preferably truncated conical elements (35), each
being suspended from the chains, wires or the like (21).

4. Loading system according to claim 3, wherein the conical elements (35) have a smaller upper diameter and a larger lower diameter or vice versa.

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5. Loading system according to claim 1, wherein the protective structure (24) is equipped with a top portion (25) being more or less flush with the adjacent sea bed (16), the top portion (25) being provided with an opening (30) communicating with the interior of the protective structure (24).

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6. Loading system according to claim 5, wherein the protective structure (24) is provided with a vertical, downwardly open cell (26) located directly below the opening (30) in the top portion (25).

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7. Loading system according to claim 1, wherein the riser (18) may be completely retracted into the protective structure (24) when idle, the riser (18) being stored on a reel (28) arranged inside the protective structure (24).

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8. Loading system according to claim 7, wherein the reel (28) rotates around a horizontal axis, the riser (18) being connected to a supply line (29) for hydrocarbons by means of a swivel, allowing the reel (28) to rotate relative to the supply line (29).

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9. Loading system according to claim 1, wherein the riser protection (20) may be completely retracted into the cell (26) when the riser (18) is not in use.

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10. Loading system according to claim 9, wherein the riser protection elements (35) are stacked on top of each other in a retracted position inside the cell (26).

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11. Loading system according to claim 1-10, wherein the riser protection (20), at its lower end, is equipped with a socket (22), intended to interact with a retaining means on the protective structure (24).
- 5 12. Loading system according to claim 11, wherein the lower ends of the supporting chains (21) are attached to the socket (22).
- 10 13. Loading system according to claim 11, wherein the socket (22) is equipped with locking means (39) for securing the socket (22) in a locked position with respect to the retaining means on the protective structure (24).
- 15 14. Loading system according to claim 13, wherein the locking means (39) are releasably arranged, enabling the socket (22) to be lowered down into the lower part of the protective structure (24) to a retracted position together with the stacked protection elements (35) when the riser
- 20 (18) is idle.
- 15 15. Loading system according to claim 11, wherein the lower part of the cell wall is provided with a retaining means to support the socket (22) when in a retracted
- 25 position within the protective structure (24).
16. Loading system according to claim 5, wherein the opening (30) at the top of the protective structure (24) is provided with a flexible deflector (34), preventing
- 30 soil to drop down into the protective structure (24) through the opening (30).
17. Loading system according to claim 11, wherein the socket (22) has an upwardly protruding, conical shape
- 35 intended to interact with the corresponding opening in the top slab (25) of the protective structure (24), thereby preventing the socket (22) from moving upwards.

18. Loading system according to claim 6, wherein a slot (33) is provided in the cell wall adjacent the reel (28).

5 19. Loading system according to claim 18, wherein the slot (33) having a height that is larger than the maximum expected vertical heave amplitude of the vessel (10) and the width of the slot (33) is larger than diameter of the riser (18).

10 20. Method for mooring a vessel (10) to a submerged turret buoy (19), c h a r a c t e r I z e d b y the steps of bringing the vessel (10) into position above a submerged riser (18), the upper end of which being provided with a submerged turret buoy (19), pulling the
15 riser (18) with its turret buoy (19) upwards into engagement with corresponding means (15) on the vessel (10), and further lifting a riser protection (20) encompassing the riser (18) upwards, protecting at least the upper portion of the riser (18).

20 21. Method for mooring according to claim 20, wherein the riser (18) is reeled out from a stored position on a reel (28) on the sea bed (16).

25 22. Method according to claim 21, wherein the riser protection means (20) is raised towards the vessel (10) from a retracted position on the sea bed (16) to an extended position in the same operation as for lifting the riser (18).

30 23. Method according to claim 21, wherein the riser (18) is reeled out from a reel (28) located in a protective structure (24) in the sea bed (16).

35 24. Method according to claim 23, wherein the riser (18) is reeled out such extent that a sagging bend is provided at the lower end of the riser (18), compensating at any time for possible heave caused by vessel (10).

25. Method according to claim 20, wherein the riser (18) and its protection means (20) may be completely retracted to an inactive position on the sea bed (16).

5 26. Method according to claims (20-25), wherein the riser (18) and its protection means (20) are stored in a retracted position on the sea bed (16), a socket (22) forming the lower end of the riser protection means (20) resting on a support inside a protective structure on the
10 sea bed (16).

27. Method according to claim 26, wherein the riser (18), the socket (22) and the riser protection means (20) and the submerged turret buoy (19) are lifted upwards until
15 the socket (22) engages with an engagement means in the top slab (25) of the protective structure (24), whereafter the riser (18) and the submerged turret buoy (19) is lifted further upwards towards the vessel subsequently lifting the riser protection means (20) from a stacked
20 position to an extended position.

28. Method according to claims 20-27, wherein the protection means (20), comprising a plurality of truncated, conical cylinders (35) suspended from each
25 other by means of chains or lines (21) are stacked on top of each other during the retraction process.

29. Method for installing a riser protection system on a sea bed,
30 c h a r a c t e r i z e d i n t h a t a protective structure (24) is established in the sea bed (16), lowering a separate, prefabricated unit comprising a reel (28), a riser (18) reeled on to the reel (28) and a top intended to form the top of the protective structure (24),
35 down into the protective structure (24) and connecting an end of the reeled riser (18) to a supply line (29) for hydrocarbons, the connection being achieved by means of a swivel.